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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/928,570	08/13/2001	Rongxiang Hu	01-099	7873

7590

03/31/2003

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EXAMINER

UMEZ ERONINI, LYNETTE T

ART UNIT

PAPER NUMBER

1765

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DATE MAILED: 03/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/928,570

Applicant(s)

HU ET AL.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) \_\_\_\_ is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

## DETAILED ACTION

### *Claim Objections*

1. Claims 1, 2, 6, and 8 are objected to because of the following informalities:

In claim 1, line 6 and

In claim 6, line 11, carbon-tetrafluorite is misspelled and should read --carbon tetrafluoride—. Appropriate correction is suggested.

In claim 2, lines 17-18 and

In claim 8, lines 27-29, "the selectivity enhancing chemical in a C:H:F ratio of about 1:1:2 to about 1:8:4" is objected to because a "selectivity enhancing chemical" is selected from the group of H<sub>2</sub> and NH<sub>3</sub>, which lacks fluorine atoms. It is unclear what chemical or chemicals are represented by the said ratio. Appropriate correction is suggested.

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily

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published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1, 3, and 4 are rejected under 35 U.S.C. 102(e) as being anticipated by Chooi et al. (US 6284657 B1).

Chooi teaches, "... a microelectronic fabrication, ... which a dual-damascene interconnect is to be formed. The fabrication comprises a first dielectric layer **(14)**, which could be ... a layer of low dielectric constant ... an etch-stop layer **(16)**, which could be a layer of silicon carbide ... (column 7, line 49 - column 8, line 5). **FIG 11** is ... view of a trench and via formation that has been patterned and etched according to either a trench first, via first or self-aligned scheme. The etching process consists of plasma-assisted dry etching wherein the etching chemistry comprises one or more of the following: fluorocarbons (e.g.  $\text{CF}_4$   $\text{C}_4\text{F}_8$ ), ... hydrogen and carbon monoxide ... The trench is etched through the optional capping layer **(20)** and the second dielectric layer **(18)**, stopping at the etch-stop layer **(16)**. The via is etched through to the passivation layer **(12)**. The aforementioned reads on,

A method for removing a silicon carbide layer during fabrication of an integrated circuit chip on a semiconductor wafer comprising:

flowing an etch chemical into proximity with a surface of the semiconductor wafer having the silicon carbide layer and a low dielectric constant material exposed thereon, the etch chemical selected from the group consisting of carbon tetrafluoride; and

etching the exposed silicon carbide layer from the surface of the semiconductor wafer substantially without removing the exposed low dielectric constant material.

Since Chooi etches the same materials using the same etchants as that of the claimed invention, then using Chooi's etching method would inherently read on,

introducing a selectivity enhancing chemical into the flow of the etch chemical, the selectivity enhancing chemical increasing the selectivity of the etch chemical to the silicon carbide layer relative to the low dielectric constant material and being selected from the group consisting of hydrogen, **as in claim 1**; and

introducing a selectivity enhancing chemical into the flow of the etch chemical prior to flowing the etch chemical into proximity with the surface of the semiconductor wafer, **as in claim 3**; and

introducing the selectivity enhancing chemical into the flow of the etch chemical substantially simultaneously with the flowing of the etch chemical into proximity with the surface of the semiconductor, **as in claim 4**.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chooi ('657 B1) in view of Conboy et al. (US 5,904,487) and Bhardwaj et al. (US 6,0541,503).

Chooi differs in failing to specify the selectivity enhancing chemical in a C:H:F ratio of about 1:1:2 to about 1:8:4, in claim 2 a temperature range of about -30 to about 80°C, a pressure range of about 5mT to about 300 mT, and a power level in a range of about 200 to about 1500 watts, in claim 5.

Conboy teaches "Etch rate across the wafer can vary with variation of one or more process parameter including . . . process parameters associated with the plasma including pressure, temperature, composition, flow rate, etc. . . and process parameters associated with the wafer such as temperature" (column 2, lines 12-17) and Bhardwaj teaches the following parameters: . . . chamber pressure, plasma power . . . I vary with time (Abstract). Hence, Conboy and Bhardwaj provide evidence that variation in plasma composition (etchant ratio), substrate temperature, chamber pressure and plasma power are so-called "result effective variables."

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chooi by varying the plasma composition, pressure, and power and substrate temperature as taught by Conboy and Bhardwaj since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 717 F.2d 272, 205 USPQ 215 (CCPA 1980).

### ***Claim Rejections - 35 USC § 102***

5. Claims 6, 7, 9 and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Chooi ('657 B1).

Chooi teaches, "... a microelectronic fabrication, ... which a dual-damascene interconnect is to be formed. The fabrication comprises a first dielectric layer (14), which could be ... a layer of low dielectric constant ... an etch-stop layer (16), which could be a layer of silicon carbide ... (column 7, line 49 - column 8, line 5). **FIG 11** is ... view of a trench and via formation that has been patterned and etched according to either a trench first, via first or self-aligned scheme. The etching process consists of plasma-assisted dry etching wherein the etching chemistry comprises one or more of the following: fluorocarbons (e.g.  $\text{CF}_4$   $\text{C}_4\text{F}_8$ ), ... hydrogen and carbon monoxide ... The trench is etched through the optional capping layer (20) and the second dielectric layer (18), stopping at the etch-stop layer (16). The via is etched through to the aestivation layer (12). The aforementioned reads on,

A method for performing a damascene metallization process during fabrication of an integrated circuit chip on a semiconductor wafer comprising:

forming a silicon carbide layer on the semiconductor wafer;

forming a layer of a low dielectric constant material on the semiconductor wafer;

removing a region of the low dielectric constant material to expose a portion of the silicon carbide layer and a portion of the low dielectric constant material; and

flowing an etch chemical into proximity with the exposed portions of the silicon carbide layer and the low dielectric constant material, the etch chemical selected from the group consisting of carbon tetrafluoride.

Since Chooi etches the same materials using the same etchants as that of the claimed invention, then using Chooi's etching method would inherently read on,

introducing a selectivity enhancing chemical into the flow of the etch chemical, the selectivity enhancing chemical increasing the selectivity of the etch chemical to the silicon carbide layer relative to the low dielectric constant material and being selected from the group consisting of hydrogen, and

removing a region of the exposed silicon carbide layer with the combined etch chemical and the selectivity enhancing chemical substantially without eroding the exposed portion of the low dielectric constant material, **as in claim 6**;

introducing the selectivity enhancing chemical into the flow of the etch chemical prior to flowing the etch chemical into proximity with the exposed portions of the silicon carbide layer and the low dielectric constant material, **as in claim 9**; and

introducing the selectivity enhancing chemical into the flow of the etch chemical substantially simultaneously with the flowing of the etch chemical into proximity with the exposed portions of the silicon carbide layer and the low dielectric constant material, **as in claim 10**.

Chooi further teaches, "**FIG. 14** . . . wherein a conducting inlay (**27**), such as a copper inlay, has been formed by a deposition of copper over all surface of said trench and said via formation . . . (column 9, lines 7-11), which read on,

forming a metal region into the removed regions of the low dielectric constant material and the silicon carbide layer, **as in claim 6**; and

forming the metal region by depositing copper (Cu) into the removed regions of the low dielectric constant material and the silicon carbide layer, **as in claim 7**.



***Claim Rejections - 35 USC § 103***

6. Claims 8 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chooi ('657 B1) as applied to claim 6 above, and further in view of Conboy ('487) and Bhardwaj ('503).

Chooi differs in failing to specify the selectivity enhancing chemical in a C:H:F ratio of about 1:1:2 to about 1:8:4, in claim 8 and a temperature range of about -30 to about 80°C, a pressure range of about 5mT to about 300 mT, and a power level in a range of about 200 to about 1500 watts, in claim 11.

Conboy teaches "Etch rate across the wafer can vary with variation of one or more process parameter including . . . process parameters associated with the plasma including pressure, temperature, composition, flow rate, etc. . . and process parameters associated with the wafer such as temperature" (column 2, lines 12-17) and Bhardwaj teaches the following parameters: . . . chamber pressure, plasma power . . . I vary with time (Abstract). Hence, the aforementioned provides evidence that variation in plasma composition (etchant ratio), substrate temperature, chamber pressure and plasma power are so-called "result effective variables."


It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chooi by varying the plasma composition, pressure, and power and substrate temperature as taught by XXX and Bhardwaj since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 717 F.2d 272, 205 USPQ 215 (CCPA 1980).

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703-308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

ltue  
March 24, 2003

  
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